

CLAIMS

What is claimed is:

1. An integrated circuit having an image sensor, wherein the image sensor has an array of one or more pixels, wherein at least one pixel in the array comprises:

(a) a photoelement formed on a substrate and configured to generate an electrical signal in response to incident light; and

(b) associated circuitry formed on the substrate and configured to process the electrical signal generated in the photoelement, wherein:

at least part of the photoelement and at least part of the associated circuitry are formed within a common insulating layer formed on the substrate, wherein a portion of the common insulating layer corresponding to the photoelement has a thickness different from a thickness of a portion of the common insulating layer corresponding to the associated circuitry.

2. The invention of claim 1, wherein the portion of the common insulating layer corresponding to the associated circuitry is thicker than the portion of the common insulating layer corresponding to the photoelement.

3. The invention of claim 1, wherein the pixel further comprises a mask layer formed on top of at least some of the associated circuitry, wherein the mask layer inhibits light incident at the associated circuitry from contributing to the electrical signal at the photoelement.

4. The invention of claim 3, wherein the pixel further comprises one or more insulating structures formed on the substrate, wherein the one or more insulating structures inhibit flow of electricity between at least one of (1) the photoelement and the associated circuitry and (2) the pixel and an adjacent pixel in the array.

5. The invention of claim 1, wherein:
the image sensor is a CMOS image sensor;

the common insulating layer comprises an oxide of silicon;

the pixel further comprises a microlens positioned over the photoelement; and

the photoelement is a photodiode, a phototransistor, a photogate, photo-conductor, a charge-coupled device, a charge-transfer device, or a charge-injection device.

6. The invention of claim 1, wherein the pixel further comprises one or more insulating structures formed on the substrate, wherein the one or more insulating structures inhibit flow of electricity between at least one of (1) the photoelement and the associated circuitry and (2) the pixel and an adjacent pixel in the array.

1 7. A method for fabricating an integrated circuit having an image sensor, wherein the image sensor has
2 an array of one or more pixels, the method comprises, for at least one pixel in the array, the steps of:

3 (a) forming a photoelement on a substrate wherein the photoelement is configured to generate an electrical
4 signal in response to incident light; and

5 (b) forming associated circuitry on the substrate wherein the associated circuitry is configured to process
6 the electrical signal generated in the photoelement, wherein:

7 at least part of the photoelement and at least part of the associated circuitry are formed within a common
8 insulating layer on the substrate, wherein a portion of the common insulating layer corresponding to the
9 photoelement has a thickness different from a thickness of a portion of the common insulating layer
10 corresponding to the associated circuitry.

1 8. The invention of claim 7, wherein the portion of the common insulating layer corresponding to the
2 associated circuitry is thicker than the portion of the common insulating layer corresponding to the
3 photoelement.

4 9. The invention of claim 7, wherein the method further comprises the step of forming a mask layer on
5 top of at least some of the associated circuitry in the pixel, wherein the mask layer inhibits light incident at the
6 associated circuitry from contributing to the electrical signal at the photoelement.

7 10. The invention of claim 9, wherein the method further comprises the step of forming one or more
8 insulating structures on the substrate within the pixel, wherein the one or more insulating structures inhibit
9 flow of electricity between at least one of (1) the photoelement and the associated circuitry and (2) the pixel
10 and an adjacent pixel in the array.

1 11. The invention of claim 7, wherein:

2 the image sensor is a CMOS image sensor;

3 the common insulating layer comprises an oxide of silicon;

4 the pixel further comprises a microlens positioned over the photoelement; and

5 the photoelement is a photodiode, a phototransistor, a photogate, photo-conductor, a charge-coupled
6 device, a charge-transfer device, or a charge-injection device.

1 12. The invention of claim 7, wherein the method further comprises the step of forming one or more
2 insulating structures on the substrate within the pixel, wherein the one or more insulating structures inhibit
3 flow of electricity between at least one of (1) the photoelement and the associated circuitry and (2) the pixel
4 and an adjacent pixel in the array.

1 13. An integrated circuit having a digital image sensor, wherein the digital image sensor has an array of
2 one or more digital pixels, wherein at least one digital pixel in the array comprises:
3 (a) a photoelement formed on a substrate and configured to generate a digital electrical signal in response
4 to incident light;
5 (b) associated circuitry formed on the substrate and configured to process the digital electrical signal
6 generated in the photoelement; and
7 (c) one or more insulating structures formed on the substrate and configured to inhibit flow of electricity
8 between at least one of (1) the photoelement and the associated circuitry and (2) the pixel and an adjacent pixel
9 in the array.

1 14. The invention of claim 13, wherein the one or more insulating structures comprise an insulating layer
2 between the substrate and at least one of (1) the photoelement and (2) the associated circuitry.

1 15. The invention of claim 14, wherein the insulating layer is between the substrate and both (1) the
2 photoelement and (2) the associated circuitry.

1 16. The invention of claim 15, wherein the one or more insulating structures comprise:
2 a first lateral insulating structure between the photoelement and the associated circuitry; and
3 a second lateral insulating structure between the pixel and the adjacent pixel in the array.

1 17. The invention of claim 13, wherein the one or more insulating structures comprise a lateral insulating
2 structure between the photoelement and the associated circuitry.

1 18. The invention of claim 13, wherein the one or more insulating structures comprise a lateral insulating
2 structure between the pixel and the adjacent pixel in the array.

1 19. The invention of claim 13, wherein:
2 the image sensor is a CMOS image sensor;
3 the common insulating layer comprises an oxide of silicon;
4 the pixel further comprises a microlens positioned over the photoelement; and
5 the photoelement is a photodiode, a phototransistor, a photogate, photo-conductor, a charge-coupled
6 device, a charge-transfer device, or a charge-injection device.

1 20. The invention of claim 13, wherein the pixel further comprises a mask layer formed on top of at least
2 some of the associated circuitry, wherein the mask layer inhibits light incident at the associated circuitry from
3 contributing to the digital electrical signal at the photoelement.

1 21. The invention of claim 13, wherein at least part of the photoelement and at least part of the associated
2 circuitry are formed within a common insulating layer formed on the substrate, wherein a portion of the
3 common insulating layer corresponding to the photoelement has a thickness different from a thickness of a
4 portion of the common insulating layer corresponding to the associated circuitry.

1 22. The invention of claim 21, wherein the pixel further comprises a mask layer formed on top of at least
2 some of the associated circuitry, wherein the mask layer inhibits light incident at the associated circuitry from
3 contributing to the digital electrical signal at the photoelement.

1 23. The invention of claim 21, wherein the portion of the common insulating layer corresponding to the
2 associated circuitry is thicker than the portion of the common insulating layer corresponding to the
3 photoelement.

1 24. A method for fabricating an integrated circuit having a digital image sensor, wherein the digital image
2 sensor has an array of one or more digital pixels, the method comprises, for at least one digital pixel in the
3 array, the steps of:

4 (a) forming a photoelement on a substrate, wherein the photoelement is configured to generate a digital
5 electrical signal in response to incident light;

6 (b) forming associated circuitry on the substrate, wherein the associated circuitry is configured to process
7 the digital electrical signal generated in the photoelement; and

8 (c) forming one or more insulating structures on the substrate, wherein the one or more insulating
9 structures are configured to inhibit flow of electricity between at least one of (1) the photoelement and the
10 associated circuitry and (2) the pixel and an adjacent pixel in the array.

1 25. The invention of claim 24, wherein the one or more insulating structures comprise an insulating layer
2 between the substrate and at least one of (1) the photoelement and (2) the associated circuitry.

1 26. The invention of claim 25, wherein the insulating layer is between the substrate and both (1) the
2 photoelement and (2) the associated circuitry.

1 27. The invention of claim 26, wherein the one or more insulating structures comprise:

1 a first lateral insulating structure between the photoelement and the associated circuitry; and
2 a second lateral insulating structure between the pixel and the adjacent pixel in the array.

1 28. The invention of claim 24, wherein the one or more insulating structures comprise a lateral insulating
2 structure between the photoelement and the associated circuitry.

1 29. The invention of claim 24, wherein the one or more insulating structures comprise a lateral insulating
2 structure between the pixel and the adjacent pixel in the array.

1 30. The invention of claim 24, wherein:
2 the image sensor is a CMOS image sensor;
3 the common insulating layer comprises an oxide of silicon;
4 the pixel further comprises a microlens positioned over the photoelement; and
5 the photoelement is a photodiode, a phototransistor, a photogate, photo-conductor, a charge-coupled
6 device, a charge-transfer device, or a charge-injection device.

31. The invention of claim 24, wherein the method further comprises the step of forming a mask layer on
top of at least some of the associated circuitry, wherein the mask layer inhibits light incident at the associated
circuitry from contributing to the digital electrical signal at the photoelement.

32. The invention of claim 24, wherein at least part of the photoelement and at least part of the associated
circuitry are formed within a common insulating layer formed on the substrate, wherein a portion of the
common insulating layer corresponding to the photoelement has a thickness different from a thickness of a
portion of the common insulating layer corresponding to the associated circuitry.

1 33. The invention of claim 32, wherein the method further comprises the step of forming a mask layer on
2 top of at least some of the associated circuitry, wherein the mask layer inhibits light incident at the associated
3 circuitry from contributing to the digital electrical signal at the photoelement.

1 34. The invention of claim 32, wherein the portion of the common insulating layer corresponding to the
2 associated circuitry is thicker than the portion of the common insulating layer corresponding to the
3 photoelement.

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